

## CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A method of forming a CMOS imaging device having different in-pixel capacitors and periphery capacitors, comprising the steps of:
  - forming at least one photosensor;
  - forming a first electrode layer over said substrate in a pixel region and a periphery region;
  - forming a first dielectric layer over said first electrode layer;
  - forming a second dielectric layer over said first dielectric layer; and
  - forming a second electrode layer over said second dielectric layer.
2. The method of claim 1, wherein said first electrode layer is formed of a material selected from the group consisting of a poly, poly/WSi, poly/WN/W, poly/silicide, poly/metal and metal.
3. The method of claim 1, wherein said first dielectric layer and said second dielectric layer are formed of a material independently selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .
4. The method of claim 1, wherein said second electrode layer is formed of a material selected from the group consisting of a polysilicon, poly/TiSi<sub>2</sub>, poly/WSi<sub>2</sub>, poly/WN<sub>x</sub>/W, poly/WN<sub>x</sub>, poly/CoSi<sub>2</sub>, poly/MoSi<sub>2</sub>, poly/metal and metal.
5. The method of claim 1, wherein said photosensor is one of a photodiode, photogate or photoconductor.

6. The method of claim 5, wherein said photodiode is a p-n-p photodiode.

7. A method of forming an imaging device having both single dielectric capacitors and dual dielectric capacitors, the method comprising the steps of:

forming at least one photosensor;

forming a first electrode layer over said substrate in a pixel region and a periphery region;

forming a first dielectric layer over said first electrode layer;

forming a second dielectric layer over said first dielectric layer;

removing said second dielectric layer in one of said pixel region and said periphery region; and

patterning a second electrode layer in said pixel region and said periphery region, such that one of said pixel region and said periphery region comprises said first dielectric layer, and the other of said pixel region and said periphery region comprises both said first dielectric layer and said second dielectric layer.

8. The method of claim 7, wherein said first dielectric layer is different from said second dielectric layer.

9. The method of claim 7, wherein said first electrode layer is formed of a material selected from the group consisting of a poly, poly/WSi, poly/WN/W, poly/silicide, poly/metal and metal.

10. The method of claim 7, wherein said first dielectric layer and said second dielectric layer are formed of a material independently selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

11. The method of claim 7, wherein said second electrode layer is formed of a material selected from the group consisting of a polysilicon, poly/TiSi<sub>2</sub>, poly/WSi<sub>2</sub>, poly/WN<sub>x</sub>/W, poly/WN<sub>x</sub>, poly/CoSi<sub>2</sub>, poly/MoSi<sub>2</sub>, poly/metal and metal.

12. The method of claim 7, wherein said photosensor is one of a photodiode, photogate, or photoconductor.

13. The method of claim 12, wherein said photodiode is a p-n-p photodiode.

14. The method of claim 7, wherein removing said second dielectric layer comprises a photoresist masking process.

15. The method of claim 7, wherein removing said second dielectric layer comprises a wet or dry etch process.

16. The method of claim 7, wherein removing said second dielectric layer comprises removing said second dielectric from said pixel region.

17. The method of claim 7, wherein removing said second dielectric layer comprises removing said second dielectric from said periphery region.

18. An imaging device, comprising:

- a semiconductor substrate;
- at least one photosensor;
- a first electrode layer over said substrate in a pixel region and a periphery region of said imaging device;
- a first dielectric layer over said first electrode layer;
- a second dielectric layer over said first dielectric layer; and

a second electrode layer over said second dielectric layer.

19. The device of claim 18, wherein said first electrode layer is formed of a material selected from the group consisting of a poly, poly/WSi, poly/WN/W, poly/silicide, poly/metal and metal.

20. The device of claim 18, wherein said photosensor is one of a photodiode, photogate or photoconductor.

21. The device of claim 18, wherein said first dielectric layer comprises a material selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

22. The device of claim 18, wherein said second dielectric layer comprises a material selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

23. The device of claim 18, wherein said second electrode layer is formed of a material selected from the group consisting of a polysilicon, poly/TiSi<sub>2</sub>, poly/WSi<sub>2</sub>, poly/WN<sub>x</sub>/W, poly/WN<sub>x</sub>, poly/CoSi<sub>2</sub>, poly/MoSi<sub>2</sub>, poly/metal and metal.

24. An imaging device, comprising:

a substrate;

at least one photosensor;

at least one in-pixel capacitor formed in the pixel array region of said substrate, said at least one in-pixel capacitor comprising a first electrode, a first plurality of dielectric layers and a second electrode; and

at least one peripheral capacitor formed in a peripheral region of said substrate, said peripheral region being adjacent said pixel array region, said at least

one peripheral capacitor comprising said first electrode, a second plurality of dielectric layers, and said second electrode.

25. The device of claim 24, wherein the capacitance of said at least one in-pixel capacitor is different from the capacitance of said at least one peripheral capacitor.

26. The device of claim 24, wherein the capacitance of said at least one in-pixel capacitor is greater than the capacitance of said at least one peripheral capacitor.

27. The device of claim 24, wherein the capacitance of said at least one peripheral capacitor is greater than the capacitance of said at least one in-pixel capacitor.

28. The device of claim 24, wherein said first electrode is formed of a material selected from the group consisting of a poly, poly/WSi, poly/WN/W, poly/silicide, poly/metal and metal.

29. The device of claim 24, wherein said first plurality of dielectric layers and said second plurality of dielectric layers are formed of a material independently selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

30. The device of claim 24, wherein said second electrode layer is formed of a material selected from the group consisting of a polysilicon, poly/TiSi<sub>2</sub>, poly/WSi<sub>2</sub>, poly/WN<sub>x</sub>/W, poly/WN<sub>x</sub>, poly/CoSi<sub>2</sub>, poly/MoSi<sub>2</sub>, poly/metal and metal.

31. The device of claim 24, wherein said photosensor is one of a photodiode, photogate or photoconductor.

32. The device of claim 31, wherein said photodiode is a p-n-p photodiode.

33. The device of claim 24, wherein said first plurality of dielectric layers is different from said second plurality of dielectric layers.

34. The device of claim 24, wherein at least one of said first plurality of dielectric layers is different from one of said second plurality of dielectric layers.

35. The device of claim 24, wherein said first plurality of dielectric layers is similar to said second plurality of dielectric layers.

36. The device of claim 24, wherein the imaging device is a CMOS imager.

37. A CMOS imager system, comprising:

(i) a processor; and

(ii) a CMOS imaging device coupled to said processor, said CMOS imaging device comprising:

a semiconductor substrate;

at least one photosensor;

a first electrode layer over said substrate in a pixel region and a periphery region of said imaging device;

a first dielectric layer over said first electrode layer;

a second dielectric layer over said first dielectric layer; and

a second electrode layer over said second dielectric layer.

38. The CMOS imager system of claim 37, wherein said processor comprises circuits for signal amplification, row addressing, column addressing, white balance, color correction, image correction, and defect correction.

39. A CCD imaging device, comprising:

a semiconductor substrate;

at least one photosensor;

a first electrode layer over said substrate in a pixel region and a periphery region of said imaging device;

a first dielectric layer over said first electrode layer;

a second dielectric layer over said first dielectric layer; and

a second electrode layer over said second dielectric layer.

40. The device of claim 39, wherein said first electrode layer is formed of a material selected from the group consisting of a poly, poly/WSi, poly/WN/W, poly/silicide, poly/metal and metal.

41. The device of claim 39, wherein said first dielectric layer is formed of a material selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

42. The device of claim 39, wherein said second dielectric layer is formed of a material selected from the group consisting of an oxide, nitride,  $\text{Al}_2\text{O}_3$ ,  $\text{Ta}_2\text{O}_5$ , BST, metal oxide and  $\text{HfO}_x$ .

43. The device of claim 39, wherein said second electrode layer is formed of a material selected from the group consisting of a polysilicon, poly/TiSi<sub>2</sub>, poly/WSi<sub>2</sub>, poly/WN<sub>x</sub>/W, poly/WN<sub>x</sub>, poly/CoSi<sub>2</sub>, poly/MoSi<sub>2</sub>, poly/metal and metal.

44. A CCD imager system, comprising:

(i) a processor; and

(ii) a CCD imaging device coupled to said processor, said CCD imaging device comprising:

    a semiconductor substrate;

    at least one photosensor;

    a first electrode layer over said substrate in a pixel region and a periphery region of said imaging device;

    a first dielectric layer over said first electrode layer;

    a second dielectric layer over said first dielectric layer; and

    a second electrode layer over said second dielectric layer,  
wherein at least one of said first dielectric layer and second dielectric layer differs between said pixel region and said periphery region to form different in-pixel capacitors and periphery capacitors.

45.       The CCD imager system of claim 44, wherein said processor comprises circuits for signal amplification, row addressing, column addressing, white balance, color correction, image correction, and defect correction.

46.       An imaging device, comprising:

    a substrate;

    at least one photosensor;

    a first type capacitor in the array and in the periphery, wherein the first type capacitor in the array is the same as the first type capacitor in the periphery, and wherein the first type capacitor comprises a first electrode, a first plurality of dielectric layers and a second electrode; and

a second type capacitor in the array, wherein the second type capacitor comprises said first electrode, a second plurality of dielectric layers, and said second electrode.

47. An imaging device, comprising:

a substrate;

at least one photosensor;

a first type capacitor in the array and in the periphery, wherein the first type capacitor in the array is the same as the first type capacitor in the periphery, and wherein the first type capacitor comprises a first electrode, a first plurality of dielectric layers and a second electrode; and

a second type capacitor in the array and in the periphery, wherein the second type capacitor in the array is the same as the second type capacitor in the periphery, and wherein the second type capacitor comprises said first electrode, a second plurality of dielectric layers, and said second electrode.

48. An imaging device, comprising:

a substrate;

at least one photosensor;

a first type capacitor in the array and in the periphery, wherein the first type capacitor in the array is the same as the first type capacitor in the periphery, and wherein the first type capacitor comprises a first electrode, a first plurality of dielectric layers and a second electrode; and

a second type capacitor in the periphery, wherein the second type capacitor comprises said first electrode, a second plurality of dielectric layers, and said second electrode.

49. A CCD imager system, comprising:

(i) a processor; and

(ii) a CCD imaging device coupled to said processor, said  
CCD imaging device comprising:

a semiconductor substrate;

at least one photosensor;

a first type capacitor in the array and in the periphery, wherein the first type capacitor in the array is the same as the first type capacitor in the periphery, and wherein the first type capacitor comprises a first electrode, a first plurality of dielectric layers and a second electrode; and

a second type capacitor in the periphery, wherein the second type capacitor comprises said first electrode, a second plurality of dielectric layers, and said second electrode.